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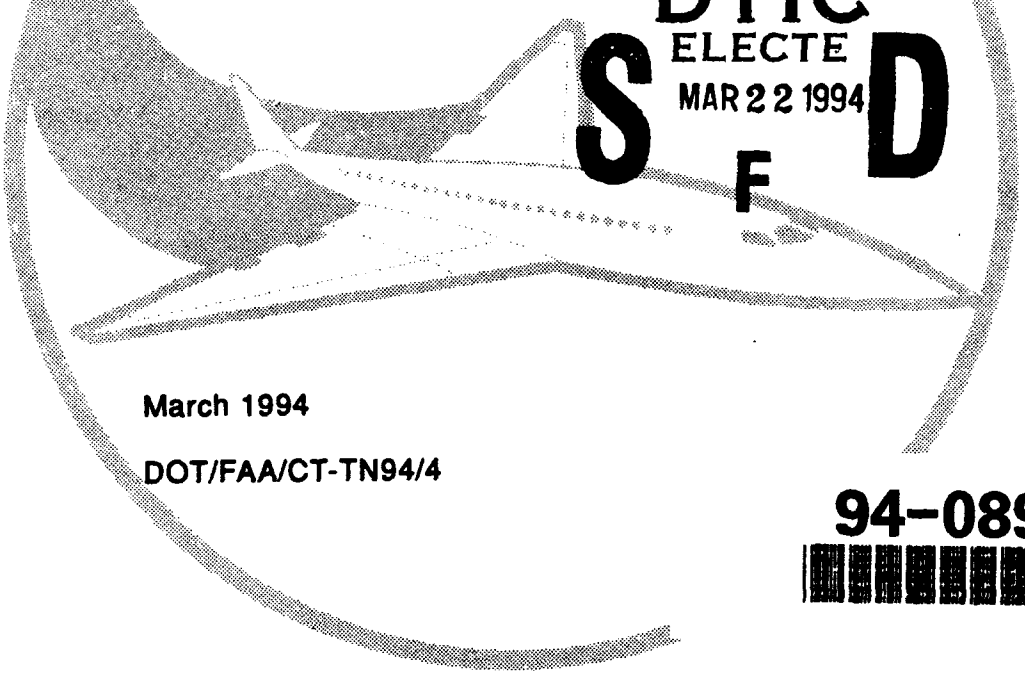
Operational Test and Evaluation (OT&E) Operational Air Traffic Control Evaluation for the Prototype Airport Surveillance Radar Wind Shear Processor (ASR-WSP) at Albuquerque International Airport

Baxter Stretcher



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16. Abstract

This report details the results of the Operational Test and Evaluation (OT&E) Operational test of the prototype Airport Surveillance Radar Wind Shear Processor (ASR-WSP). The ASR-WSP evaluation was conducted at the Albuquerque International Airport (ABQ) during the period August 2 to September 2, 1993.

The objective of the OT&E Operational Test was to obtain Federal Aviation Administration (FAA) air traffic controller reaction to the prototype ASR-WSP weather data and display equipment. Questionnaire forms were used to obtain responses from supervisors and controllers relative to the operational suitability and effectiveness of the displays and data.

This report includes the supervisors' and controllers' evaluation of the quality and quantity of the information provided by the ASR-WSP on the two displays; the Geographical Situation Display (GSD) and the Ribbon Display Terminal (RDT).

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EXECUTIVE SUMMARY

The Airport Surveillance Radar Wind Shear Processor (ASR-WSP) is a prototype modification, developed by the Massachusetts Institute of Technology Lincoln Laboratory (MIT/LL), that will interface with a production Airport Surveillance Radar (ASR), 8 or 9, to enhance its weather channel to automatically detect thunderstorm-generated low altitude wind shear phenomena such as microbursts and gust fronts.

An Operational Test and Evaluation (OT&E) Operational evaluation of a prototype ASR-WSP was conducted at the Albuquerque International Airport (ABQ) during the period August 2 to September 2, 1993. The objective of the evaluation was to obtain Federal Aviation Administration (FAA) air traffic controller reaction to the prototype ASR-WSP weather data and display equipment. The displays consisted of one Geographical Situation Display (GSD) and one large Ribbon Display Terminal (RDT) in the control tower cab and a GSD and RDT located in the Terminal Radar Approach Control (TRACON) room. Questionnaire forms were used to obtain responses from supervisors and controllers relative to the operational suitability and effectiveness of the displays and data.

The following are highlights of the evaluation: (1) the ASR-WSP is very useful when making runway configuration changes and alerting pilots to wind shear and microburst information, (2) the gust front prediction feature needs refining in order to provide an earlier warning of an approaching wind change, (3) the 15" nonstandard Terminal Doppler Weather Radar (TDWR) proved the RDT is too large, and (4) the audio alarms are not completely satisfactory.

Generally, the participants found the system to be of great benefit in providing pilots with current adverse weather location and severity. However, better planning is necessary in the placement of the displays and improvement of the gust front prediction feature. It is recommended that more testing, particularly on the gust front feature, be performed in the future since this could be a most valuable product. Furthermore, research is needed to determine the optimum method for presenting audio alarms in the air traffic environment.

1. INTRODUCTION.

1.1 PURPOSE.

The Airport Surveillance Radar Wind Shear Processor (ASR-WSP) test-bed system was deployed to Albuquerque International Airport (ABQ) for operations during the 1993 and 1994 thunderstorm seasons. The evaluation was conducted by the Federal Aviation Administration (FAA) Technical Center, ACW-200D representative with operational air traffic control (ATC) personnel at the ABQ Air Traffic Control Tower (ATCT) as evaluation participants. The purpose of the test was to evaluate the following products issued by the ASR-WSP as microburst detections, gust front detections, storm movement predictions, and anomalous propagation censoring, and also to assess the operational utilization of these products. Operation of the test-bed system in Albuquerque provided data on high altitude, dry microburst phenomena (wind shear events with very low radar cross-section) whereas previous tests were accomplished in a moist climate. This evaluation was conducted in order to evaluate the operational suitability and effectiveness of the prototype ASR-WSP in a high altitude, dry environment.

1.2 OVERVIEW.

The Massachusetts Institute of Technology, Lincoln Laboratory (MIT-LL), operating in support of the FAA Terminal Radar Program, ANR-200, has developed a Wind Shear Processor (WSP) modification that will interface with the Airport Surveillance Radars (ASRs) 8 and 9. The modification will enable the ASR radars to automatically detect thunderstorm-generated low altitude wind shear phenomena such as microbursts and gust fronts. The ASR-WSP modification will be deployed nationally at approximately 58 ASR sites beginning in 1997. The test-bed system has been operating since 1987, at Huntsville, AL; Kansas City, KS; and Orlando, FL, to obtain data for algorithm development, and to demonstrate the ASR-WSP system in operational air traffic control environments.

This report provides results of the Operational Test and Evaluation (OT&E) Operational evaluation of the prototype ASR-WSP conducted by the FAA Technical Center at the ABQ ATCT during the period August 2 to September 2, 1993.

2. REFERENCE DOCUMENTS.

The following documents were used in the preparation of this report:

Preparation of Test and Evaluation Documentation	FAA-STD-024a August 17, 1987
FAA NAS Test and Evaluation Policy	Order 1810.4B October 22, 1992

Operational Test and Evaluation (OT&E) Operational Air Traffic Control Evaluation Plan for the Prototype Airport Surveillance Radar Wind Shear Processor (ASR-WSP) at Albuquerque International Airport

DOT/FAA/CT-TN93/19
October 1993

Airport Surveillance Radar Wind Shear Processor (ASR-WSP) Questionnaire

July 10, 1993

3. SYSTEM DESCRIPTION.

3.1 MISSION REVIEW.

The primary mission of the ASR-WSP is the timely detection and reporting of hazardous wind shear phenomena in and near the terminal approach and departure zones of the airport. The secondary mission is the detection of gust fronts or wind shift lines that will subsequently impact airport operations. Two additional missions enhance the operational utility of six-level weather reflectivity information provided by the ASR-WSP. The ASR-WSP system is designed to calculate and display six-level precipitation reflectivity and storm motion vectors and utilize Doppler and/or elevation-angle information to censor false weather echoes caused by anomalous propagation of the radar frequency energy.

3.2 TEST SYSTEM CONFIGURATION.

The ASR-WSP test bed consists of a production ASR-9 with hardware and software modifications necessary to extract low-altitude wind shear information. The ASR-9 antenna is situated on a 27-foot tower. Included is an Air Traffic Control Beacon Interrogator (ATCBI-5) and a 5-foot array antenna. A "C" band meteorological Doppler weather radar was operated nearby to provide "truth" for evaluation and refinement of the WSP's wind shear detection algorithms. Two Geographical Situation Displays (GSD) and two Ribbon Display Terminals (RDT) were used to display data derived from the ASR-WSP system.

4. TEST DESCRIPTION.

4.1 TEST SCHEDULE AND LOCATION.

The ASR-WSP evaluation took place in the Albuquerque air traffic control facility at the ABQ in New Mexico. This report is based on an evaluation that included a full system operation which ran from August 2 to September 2, 1993, from 1:00 p.m. to 8:00 p.m. Mountain Daylight Time (MDT) daily. A National Airspace System (NAS) Change Proposal (NCP) was initiated at the Washington Headquarters level to waive the commissioned use of the Low Level Wind Shear Alert System (LLWAS) and to have

its displays covered. Controllers were to utilize the data displayed on the WSP RDT only. (This was later changed to allow the controllers to observe the LLWAS also.) A local Notice to Airmen (NOTAM) was sent out by the ABQ Air Traffic Manager (ATM) and the Automatic Terminal Information Service (ATIS) broadcast information that the ASR-WSP was being evaluated and pilots could expect to receive wind shear and microburst information when this phenomena occurred.

4.2 PARTICIPANTS.

Supervisors and ATCSs were trained on the use and interpretation of the GSD and RDT during the period July 13 to August 1, 1993. Personnel associated with MIT/LL provided the training to 6 supervisors, 2 Air Traffic Assistants (ATAs), and 30 Air Traffic Control Specialists (ATCSs). These personnel served as evaluators of the ASR-WSP. During the fourth week of the evaluation, the evaluators were each given a questionnaire developed and produced by FAA Technical Center personnel to record their evaluations. Six supervisors, two ATAs, and nine controllers responded.

4.3 TEST EQUIPMENT.

There were two types of displays utilized by the air traffic evaluators using the ASR-WSP system; (1) a GSD which provides a graphical map showing the locations of precipitation cells, microbursts, gust fronts, speed and direction of storm cell movement, and (2) predicted locations of gust fronts every 10 or 20 minutes in the future. This display was used by the air traffic supervisor in planning traffic flow and runway selection during severe weather activity. Physically, the GSD is a SUN-4 engineering work station with a 17-inch color monitor. A GSD was placed in the back of the tower cab (due to lack of space) and another was placed in the Terminal Radar Control (TRACON) on the supervisor's desk.

The second display is called a RDT. The RDT provides a runway-specific, alphanumeric wind shear alert (WSA) and microburst alert (MBA) message intended for readout by local controllers to pilots at the time of issuing clearance for landing or takeoff. Physically, the Ribbon Display is a 15-inch plasma display monitor (Large TDWR RDT). A RDT was placed on the tower console between the Local Control and Ground Control positions and on the supervisor's desk in the TRACON. The alert warning messages were displayed on the RDTs in the following form:

For Example:

Runway ID	Wind Shear Type	Expected Loss/Gain	Location 1st Encounter	Threshold Wind (dir/kts)
26A	WSA	40K+	3MF	320 20

This is read as: "Runway 26 arrival, wind shear alert, expect 40 knots gain, 3-mile final, threshold wind 320 at 20 knots."

4.4 TEST OBJECTIVES.

The ASR-WSP operational evaluation was conducted in order to verify that the data received on wind shear and microburst conditions is operationally suitable and effective for air traffic supervisors and controllers. The GSD and RDT were evaluated from the perspective of the ATCSs and supervisors.

4.4.1 Test Objective Overview.

Early on during the evaluation a situation occurred where the LLWAS alarmed and indicated that a wind shear was present, however, the ASR-WSP displays did not indicate that a wind shear was present. A NAS NCP initiated by the Washington Program Office called for the LLWAS display to be covered during the period of the evaluation. It was decided to remove the cover so that the ATCS would be able to alert pilots with LLWAS wind shear information in the event that a similar situation should occur. In the meantime MIT/LL was made of this problem and immediately took action to modify the software in order that LLWAS alarm data would be displayed on the RDT. This modification was still being tested by MIT/LL following the end of the evaluation.

4.5 DATA COLLECTION AND ANALYSIS METHOD.

In order to obtain feedback from the evaluators, ACW 200D developed a questionnaire (appendix A). The questionnaire was divided into specific areas regarding the GSD and RDT, as well as some general aspects of the ASR-WSP system. The questionnaire was structured to obtain the evaluation of the prototype ASR-WSP by rating a statement about each feature/function on a five-point scale ranging from very poor to very good, plus a "do not know" category for controllers who did not see a specific feature working. Comments were encouraged. Open-ended questions were also asked in order to obtain more feedback on specific features.

The questionnaire responses were assigned numerical values (1=very poor to 5=very good). The responses to open-ended questions and comments were analyzed for content and to provide additional controller feedback (appendix B).

5. RESULTS AND DISCUSSION.

Seventeen persons participated in the evaluation: six supervisors, two ATAs and nine controllers. The mean, standard deviation, and number of respondents for the GSD and RDT sections of the questionnaire are presented in tables 1 and 3, respectively. The percentage ratings for the GSD and RDT sections of the questionnaire are presented in tables 2 and 4, respectively.

5.1 GEOGRAPHICAL SITUATION DISPLAY.

The rating responses to Question #1, A through L of the GSD section of the questionnaire are shown in tables 1 and 2 on the following pages. Table 1 shows the number of respondents, mean value and standard deviation of the responses to the GSD questionnaire and table 2 shows a summary of participants' ratings for each question on the GSD questionnaire. The percentage of total participants who responded to each rating on the scale is also shown. Overall, the GSD received a mean rating of good or very good. Only one item was rated as very poor; the audible alarm. It was rated by two respondents as very poor. This rating is discussed later in this section. The participants, in general, felt that the GSD was useful in their operations.

The data from Questions 2 through 8 which provides the participant responses to the open-ended questions on the questionnaire is presented in this section following tables 1 and 2. Appendix B contains a list of all of the respondents' comments.

TABLE 1. QUESTION #1 - RESPONSES, MEAN AND STANDARD DEVIATION FOR GSD

Key:1=very poor, 2=poor, 3=fair, 4=good, 5=very good, ?=do not know.

QUESTION NO.	NUMBER OF RESPONDENTS	MEAN	STANDARD DEVIATION
A. Microburst Alerts (MBA)			
1. graphical display	15	4.80	.41
2. timeliness	14	4.79	.42
B. Wind Shear Alerts (WSA)			
1. graphical display	14	4.50	.94
2. timeliness	12	4.42	1.00
C. Gust Front Alerts			
1. graphical display	15	4.60	.83
2. timeliness	15	4.53	.83
D. Storm Motion Prediction			
1. graphical display	17	4.94	.24
2. timeliness	17	4.94	.24
E. Anomalous Propagation			
1. graphical display	13	4.77	.60
2. timeliness	13	4.77	.24
F. Daytime Readability	17	5.00	0.0
G. Nighttime Readability	17	5.00	0.0
H. Readability in TRACON	14	4.64	.63
I. Size of GSD	17	4.53	.87
J. Situation Display Window			
1. graphic display	16	4.69	.60
2. weather alerts display	16	4.69	.60
3. status display	16	4.69	.60
4. product description	16	4.75	.58
5. time/date	16	4.50	.73
K. Trackball Operation	16	4.38	1.02
L. Alarms			
1. graphic	16	4.38	.81
2. audible	14	3.71	1.59

TABLE 2. QUESTION #1 - RESPONSES, PERCENTAGE RATINGS FOR GSD

Question No.	Very Poor 1 (%)	Poor 2 (%)	Fair 3 (%)	Good 4 (%)	Very Good 5 (%)	Do Not Know (%)
A.1.				3 (17.6)	12 (70.6)	2 (11.8)
A.2.				3 (17.6)	11 (64.7)	3 (17.6)
B.1.		1 (5.9)	1 (5.9)	2 (11.8)	10 (58.8)	3 (17.6)
B.2.		1 (5.9)	1 (5.9)	2 (11.8)	8 (47.1)	4 (23.5)
C.1.		1 (5.9)		3 (17.6)	11 (64.7)	2 (11.8)
C.2.		1 (5.9)		4 (23.5)	10 (58.8)	2 (11.8)
D.1.				1 (5.9)	16 (94.1)	
D.2.				1 (5.9)	16 (94.1)	
E.1.			1 (5.9)	1 (5.9)	11 (64.7)	4 (23.5)
E.2.			1 (5.9)	1 (5.9)	11 (64.7)	4 (23.5)
F.					17 (100)	
G.					17 (100)	
H.			1 (5.9)	3 (17.6)	10 (58.8)	3 (17.6)
I.		1 (5.9)	1 (5.9)	3 (17.6)	12 (70.6)	
J.1.			1 (5.9)	3 (17.6)	12 (70.6)	1 (5.9)
J.2.			1 (5.9)	3 (17.6)	12 (70.6)	1 (5.9)
J.3.			1 (5.9)	3 (17.6)	12 (70.6)	1 (5.9)
J.4.			1 (5.9)	2 (11.8)	13 (76.5)	1 (5.9)
J.5.			2 (11.8)	4 (23.5)	10 (58.8)	1 (5.9)
K.		1 (5.9)	3 (17.6)	1 (5.9)	11 (64.7)	
L.1.			3 (17.6)	4 (23.5)	9 (52.9)	1 (5.9)
L.2.	2 (11.8)	2 (11.8)	1 (5.9)	2 (11.8)	7 (41.2)	3 (17.6)

The following paragraphs summarize the respondents' answers to the GSD Questionnaire.

Question #1.

Microburst Alert. The graphical display for the microburst alert of the GSD was rated Good or Very Good by 88.2 percent of the respondents. Two (11.8 percent) participants responded "do not know" to the question about the microburst alert graphical display.

Timeliness of the microburst alert was rated Good or Very Good by 82.3 percent of respondents. Three (17.6 percent) of the participants responded "do not know" to the question about the timeliness of the microburst alert.

Discussion: Based on the positive responses to the questionnaire, the microburst alert graphic display and timeliness of the alert are acceptable from the perspective of the evaluation participants.

Wind Shear. The graphical display for wind shear alert was rated Good or Very Good by 70.6 percent of respondents. One participant (5.9 percent) rated the wind shear alert graphical display Fair and one participant (5.9 percent) rated the display Poor. Three (17.6 percent) respondents answered "do not know" about the wind shear graphical display.

The timeliness of wind shear alerts was rated Good or Very Good by 58.9 percent of the respondents. One participant (5.9 percent) rated the timeliness of the wind shear alert Fair and one participant (5.9 percent) rated the timeliness Poor. Four respondents (23.5 percent) responded that they "do not know" about the timeliness of the wind shear alert.

Discussion: The results of the user evaluation of the wind shear alerts are inconclusive, based on the limited number of responses and the variability of the responses to that question. There were no comments written on the questionnaire to explain the variability of responses to that question.

Gust Front. The graphical display for gust front alerts was rated Good or Very Good by 82.3 percent of the respondents. One participant (5.9 percent) rated the display as Poor. Two participants (11.8 percent) responded "do not know" to the question about the graphical display for gust front alerts.

The timeliness of the gust front alert was rated Good or Very Good by 82.3 percent of the respondents. One participant (5.9 percent) rated gust front alert timeliness as Poor. Two participants (11.8 percent) responded "do not know" about the timeliness of the gust front alert.

Discussion: Overall, the numerical values of the rating data indicated that the gust front graphic display and timeliness were acceptable, the mean response was 4.6 and 4.5, respectively. There were 14 positive responses and one negative response to the open-ended question "Does the GSD information improve the management of air traffic in the terminal area through the forecast of Gust Front induced wind fronts?" There was one positive comment to the open-ended question that noted that this was "Best feature." However, there were negative comments

regarding the gust front forecast: "Timeliness was not satisfactory. Generally, the information has been displayed inefficiently." "This function didn't work as well as others. Several wind shifts occurred without any advanced notice." "Problem noted with T-storm along mountains moving north. Received little warning of strong winds coming out of the East across the airport. First real warning was heavy dust movement in construction area northeast of control tower." These participants' comments indicated some degree of dissatisfaction with aspects of the gust front forecast. Results indicated that gust front forecast is acceptable, however, based on user comments, the timeliness of the forecast needs improvement. Overall, the gust front was rated Good or Very Good by 100 percent of the respondents.

Storm Motion Prediction. The graphical display for storm motion prediction was rated Good or Very Good by 100 percent of the respondents.

The timeliness of storm motion prediction was also rated Good or Very Good by 100 percent of the respondents.

Discussion: The storm motion prediction graphical display and timeliness of the display are totally acceptable from the perspective of the user participants.

Anomalous Propagation. The graphical display for anomalous propagation censoring was rated Good or Very Good by 70.6 percent of the respondents. One participant (5.9 percent) rated the display as Fair. Four participants (23.5 percent) responded "do not know" about the anomalous propagation censoring display.

The timeliness of anomalous propagation censoring was rated Good or Very Good by 70.6 percent of the respondents. The timeliness was rated fair by one participant (5.9 percent). Four participants (23.5 percent) responded "do not know" about the timeliness of anomalous propagation censoring.

Discussion: The mean ratings for the anomalous propagation censoring graphic display and timeliness of the display were both 4.77. Four of the respondents answered "do not know" causing the low percentage of ratings of Good or Very Good. However, there were no ratings that indicated that the anomalous propagation graphic display and timeliness were unacceptable. One respondent commented that "possibly due to the characteristics of the ASR-9, large areas of moisture with little air movement are not displayed."

Readability. The daytime readability of the GSD was rated Very Good by 100 percent of the respondents.

The nighttime readability of the GSD was also rated Very Good by 100 percent of the respondents.

The readability of the GSD in the TRACON was rated Good or Very Good by 76.4 percent of the respondents. One participant (5.9 percent) rated the readability of the GSD in the TRACON Fair. Three participants (17.6 percent) responded "do not know" about the readability of the GSD in the TRACON.

Discussion: The three questions about the readability of the GSD indicated user satisfaction with this aspect of the GSD.

Size. The size of the GSD was rated Good or Very Good by 88.2 percent of the respondents. One respondent (5.9 percent) rated the size Fair and one respondent rated the GSD size Poor. No one answered "do not know" to this question.

Discussion: The mean response to the question about the size of the GSD was 4.5. One participant commented that the GSD "should be reduced in size, if possible." However, based on the numerical responses to this question, the size of the GSD is acceptable to the majority of user participants in the evaluation.

Situation Display. The situation display window layout graphic display was rated Good or Very Good by 88.2 percent of the respondents. One participant (5.9 percent) rated the graphic display Fair. One participant (5.9 percent) responded "do not know" to the question about the situation display window layout graphic display.

The situation display window layout of the weather alerts display was rated Good or Very Good by 88.2 percent of the respondents. One participant rated the weather alerts display Fair. One participant responded "do not know" to this question.

The situation display window layout of the status display was rated Good or Very Good by 88.2 percent of the respondents. One participant (5.9 percent) rated the display Fair. One participant (5.9 percent) responded "do not know" to the question about the status display of the situation display window.

The situation display window layout product description was rated Good or Very Good by 88.3 percent of the respondents. One participant (5.9 percent) rated the product description Fair. One participant (5.9 percent) responded "do not know" to the question.

The situation display window layout for the time/date was rated Good or Very Good by 82.3 percent of the respondents. Two participants (11.8 percent) rated the time/date Fair . ne participant (5.9 percent) responded "do not know" to the question.

Discussion: Overall, all situation display window layouts were rated Good or Very Good by more than 80 percent of participating respondents. There were no additional user comments about the situation display window on the questionnaires. The situation display window layouts appear to be satisfactory from the perspective of the user participants.

Trackball. The trackball operation of the GSD was rated Good or Very Good by 70.6 percent of the respondents. Three participants (17.6 percent) rated the trackball Fair and one participant rated the trackball Poor. No participant answered this question as "do not know."

Discussion: The numerical responses to the question rating the operation of the trackball were variable. In addition, there were two negative comments on the open-ended portion of the questionnaire: "Trackball is too sensitive." "Too many/much motion required to obtain one operation." Based on the variable ratings and negative responses, we suggest that further testing should be conducted to test the acceptability of the dynamic characteristics of the trackball.

Alarms. The GSD graphic alarms were rated Good or Very Good by 76.4 percent of the respondents. Three respondents (17.6 percent) rated the graphic alarm Fair. One participant (5.9 percent) responded "do not know" to this question.

The audible alarms were rated Good or Very Good by 53 percent of respondents. One participant (5.9 percent) rated the audible alarm Fair. Two participants (11.8 percent) rated the audible alarms Poor and two participants (11.8 percent) rated the audible alarms as Very Poor. Three participants (17.6 percent) responded "do not know" to the question about audible alarms.

Discussion: The GSD graphic alarms did not receive any negative ratings on the numeric rating scale, although only 76.4 percent of the respondents rated the alarms as Good or Very Good. There were also no additional comments on the questionnaire regarding these alarms. Based on these ratings, the graphic alarms appear to be acceptable from the perspective of user participants.

Responses to the question about the audible alarms, however, indicate a problem with this aspect of the GSD. First, there were comments about the audibility of the alarms: "I don't remember any alarms going off." "I didn't hear the alarms a couple of times." Other comments about the alarms were: "Needs more alarms per event." "I would like an audible alarm to alert the user of a significant change (perhaps 5 or 10 knots) during an alarm." The audible alarms were not shown to be totally acceptable from the user participant perspective. Note: The controller team that was on duty when the MIT/LL contractor was setting up the GSD was asked how high they wanted the volume on the GSD set. It was unanimous that the volume be set at the first lowest setting. The fact that the GSD was placed about 15 feet behind any tower or TRACON control position had quite a bearing on audibility. It should be noted that the system can also be adjusted as to the frequency of the alarm. Research is needed to determine the optimum method to present auditory alarms for GSD displays.

Additional Issues. Several additional issues were addressed on the open-ended section of the questionnaire. The following paragraphs present the results and discussion of those questions.

Question #2.

This question asked if there were any distortions or flickers on the GSD. The comments indicated that none were observed (Yes=0 No=16 and Do Not Know=1).

Discussion: From the comments it can be concluded that there were no problems with distortions or flickers on the GSD Display.

Question #3.

The six colors depicting the intensity of the precipitation were satisfactory to 16 of the 17 respondents. Only one replied "do not know."

Discussion: None.

Question #4.

Fourteen of the 17 respondents felt that the GSD information on the forecast of the gust front induced wind shift improved the management of air traffic in the terminal area. Two respondents did not know and only one said No.

Discussion: It should be noted that the management of air traffic in the terminal area is primarily the duty of the air traffic controllers' supervisors.

Question #5.

Sixteen of the 17 respondents felt that the GSD information on the storm motion prediction products improved the management of air traffic in the terminal area. One respondent did not know.

Discussion: The respondents seem to have been satisfied with the GSD storm motion prediction information. There was no further discussion on this question.

Question #6.

GSD Menus, Prompts and Error Messages. Thirteen respondents (76.5 percent) felt that the GSD menus, prompts, and error messages were acceptable and adequate for the required multistep tasks. Three of the respondents (17.6 percent) did not agree and one (5.9 percent) did not know. Participant comments were: "The runway selection menu procedure seems very cumbersome."; "The menus are confusing. A clear menu bar should be provided instead of the scattered buttons."; "Very easy to use for people without computer experience."; and "I would like to see more reliability."

Discussion: It would appear that the respondents need more training and experience on the GSD menus prompts and messages. Their various comments seem to indicate that more hands-on experience and explanations of the menus, prompts, and messages would help for a better understanding and use of this feature of the GSD.

Question #7.

Does the anomalous propagation editing product improve the radar presentation when compared with the BRITE? Thirteen user participants (76.5 percent) reported that the anomalous propagation editing product improved the radar presentation when compared with the BRITE display. Four participants (23.5 percent) reported that they did not know if the radar presentation was improved.

Discussion: There were no comments indicating dissatisfaction with this product. Based on these data, the anomalous propagation editing product was an improvement, from the user participants' perspective.

General Comments. Several user participants reported that they liked the GSD display. In fact, seven respondents specifically stated that the GSD equipment was very useful. (Specific comments are found in appendix B.) Based on the respondents comments the most concern was the location of the GSD. Most of the users would like the GSD to be near the radar control position.

Question #8.

Additional Comments. See Appendix B.

Discussion: The major comments from the users concerning the GSD were about the location of the GSD and its usefulness. They felt that the GSD should be closer to the Local Control. They also felt that the GSD was a useful tool and provided better service, that the GSD provided good information, and that the graphics were very well done.

5.2 RIBBON DISPLAY TERMINAL RESPONSE AND DISCUSSION.

Table 3 below shows the number of respondents, mean value, and standard deviation for question #1 of RDT section of the questionnaire. Most of the respondents' ratings were that the RDT was Good or Very Good.

TABLE 3. QUESTION #1 - RESPONSES, MEAN AND STANDARD DEVIATION FOR RDT

QUESTION NO.	NUMBER OF RESPONDENTS	MEAN	STANDARD DEVIATION
A. Microburst Alerts (MBA)			
1. format	12	4.58	.90
2. timeliness	11	4.45	.82
B. Wind Shear Alerts (WSA)			
1. format	13	4.54	.88
2. timeliness	14	4.21	1.19
C. Center Field Wind Mags	15	4.73	.46
D. Daytime Readability	15	4.73	.46
E. Nighttime Readability	17	4.94	.24
F. Readability in TRACON	15	4.53	.43
G Alarm Adjustment	9	4.44	.53

Table 4 shows a summary of participants' ratings for each section of question #1 on the RDT questionnaire. The percentage of total participants that responded to each rating on the scale is also shown.

TABLE 4. QUESTION #1 - RESPONSES, PERCENTAGE RATINGS FOR RDT

Question No.	Very Poor (%)	Poor (%)	Fair (%)	Good (%)	Very Good (%)	Do Not Know (%)
A.1.		1(5.9)		2(11.8)	9(52.9)	5(29.4)
A.2.			2(11.8)	2(11.8)	7(41.2)	6(35.2)
B.1.		1(5.9)		3(17.6)	9(52.9)	4(23.5)
B.2.		2(11.8)	2(11.8)	1(5.9)	9(52.9)	3(17.6)
C.				4(23.5)	11 (64.7)	2 (11.8)
D.				4(23.5)	11(64.7)	2(11.8)
E.				1(5.9)	16(94.1)	
F.	1(5.9)			3(17.6)	11(64.7)	2(11.8)
G.				5(29.4)	4(23.5)	8(47.1)

The following paragraphs summarize the respondent's answers to the RDT questionnaire.

Question #1.

A. Microburst Alert. The format of RDT microburst alerts was rated Good or Very Good by 64.7 percent of respondents. One respondent (5.9 percent) rated the format of the alert Poor. Five participants (29.4 percent) responded "do not know" to the question about the format of the MBA.

The timeliness of the MBA was rated Good or Very Good by 53.0 percent of the respondents. Two participants (11.9 percent) rated the timeliness of the MBA Fair and six participants (35.2 percent) responded "do not know" to the question.

Discussion: User responses to questions about the RDT microburst alert format and timeliness of the alert were variable. One of the reasons for this variability could be that 29.4 percent and 35.2 percent, respectively, of the respondents reported that they did not know about the format or timeliness of the microburst alert. No additional comments were given on the questionnaire regarding the alert, therefore, no conclusions can be drawn from these data. Additional testing is needed before any definitive conclusions can be drawn.

B. Wind Shear Alerts. The format of the WSA was rated Good or Very Good by 70.5 percent of respondents. One participant (5.9 percent) rated the timeliness of the WSA Poor. Four (23.5 percent) participants responded "do not know" to the question.

The format of the WSA was rated Good or Very Good by 58.8 percent of respondents. Two respondents (11.8 percent) rated the format of the WSA Fair and two respondents rated the format Poor. Three participants (17.6 percent) responded "do not know" to the question.

Discussion: The responses to the questions about the format and timeliness of the wind shear alert were also variable, primarily because of the percentage of user participants who responded "do not know" to the questions. One participant noted that "WSAs needed to be pretty close to the airport to display. I felt that better information from my position's standpoint was obtained from the GSD..." No conclusions can be drawn from these data, therefore, we suggest that additional testing is needed before any definitive conclusions can be drawn.

C. Centerfield Wind Messages. The RDT Centerfield wind messages were rated Good or Very Good by 88.2 percent of the respondents. Two participants (11.8 percent) responded "do not know" to the question.

Discussion: The numerical responses to this question indicate that the RDT centerfield wind messages are acceptable from the users' perspective.

D and E. Readability. The daytime readability of the RDT was rated Good or Very Good by 88.2 percent of the respondents. Two participants (11.8 percent) responded "do not know" to the question.

The nighttime readability of the RDT was rated Good or Very Good by 100 percent of the respondents.

Discussion: Overall, respondents rated the readability of the RDT positively. One respondent, however, rated the readability of the display in the TRACON Very Poor. There was no explanation for this negative rating in the open-ended portion of the questionnaire. Based on the numerical responses, it appears that a majority of user participants found the readability of the display acceptable in all locations.

F. Tracon Readability. The readability of the RDT in the TRACON was rated Good or Very Good by 82.3 percent of the respondents. One participant (5.9 percent) rated the readability of the RDT in the TRACON Very Poor. Two participants (11.8 percent) responded "do not know" to the question.

G. Alarm Adjustment. The RDT alarm adjustment was rated Good or Very Good by 52.9 percent of the respondents. Eight participants (47.1 percent) responded "do not know" to the question about the alarm adjustment.

Discussion: Only nine of the 17 respondents rated the alarm adjustment. The numerical data for this question are inconclusive because of the limited number of ratings. However, responses to the alarm question on the open-ended portion of the questionnaire indicate that the alarm is not audible to some of the respondents. There were only 29.4 percent of the participants who reported that the aural alarm

was satisfactory when MBAs and WSAs are hitting different runways and being displayed on the RDT at the same time. There were 23.5 percent who disagreed and 47.1 percent who did not know. The same factor that was present in the GSD setup was also present in the RDT. It is difficult to add yet another alarm sound to the air traffic control environment and expect to obtain any satisfaction from the controller. This may indicate that the audio alarm is not yet satisfactory from the users' perspective. All additional comments to addressing the alarm issue were negative (n=7). The specific comments are found in appendix B.

General RDT Comments. General comments about the RDT were mixed. The size of the RDT appeared to be a problem for some respondents, for example, "The RDT is way too big..." Representative positive comments are: "Easy to read"; "The ability to configure to actual runways in use is excellent." Appendix B contains specific comments from user participants.

Discussion: In general, the respondents felt that the location and the size of the RDT were not satisfactory. This was due to the limited space and the obstruction of visibility in the tower. It should be noted that this test configuration used the Large RDT. The TDWR production system used the Small RDT.

Question #2.

Aural Alarm. The question asked if the aural alarms were satisfactory when multiple MBAs and WSAs were hitting different runways and being displayed on the RDT at the same time. Five respondents said YES, four said NO, and eight said do not know. The comments (See appendix B) ranged from "did not hear an alarm" to "I did not hear it a couple of times."

Discussion: The responses and comments from the respondents indicate that the aural alarms were not satisfactory. It should be noted that the volume and frequency of the alarms can be adjusted on the RDT. (Some users were not aware of this.) This might account for some users not hearing the alarm at times. The alarms should be tested for optimum use as for volume and frequency.

Question #3.

Other Comments. See Appendix B.

Discussion: The major comments about the RDT were: (1) the size (too large), (2) the alarms (not always heard by some respondents), and (3) information (easy to read). These are concerns that require further study.

5.3 GENERAL ASR-WSP QUESTIONS AND COMMENTS.

Question #1.

Training: All user participants felt that they received suitable training to allow use of the RDT and GSD.

Discussion: None.

Questions #2 and #3.

Benefits and Problems: Appendix B lists the user participants' responses to the opportunity to address their view of the benefits and problems of implementation of ASR-WSP. Overall, the comments were very positive. There were some respondents who reported that there was a problem with the location and size of the equipment. The participants were informed that the location was only temporary for purposes of the evaluation, however, some still felt the need to comment about the issue.

Discussion: The benefits of the ASR-WSP seems to outweigh the problems. The location of the equipment in the tower can be adjusted, however the size of the equipment (in particular the RDT) should be studied further. The production RDT for the TDWR and possibly the ASR-WSP, is Small. Only the Large RDT was available for this test. However, the Small RDT is going into the commissioned TDWR (and possible ASR-WSP) sites in time.

Question #4.

Comparison with the LLWAS: There were 13 respondents who reported that the ASR-WSP is more effective in detection and display of wind shear alerts. Only one respondent disagreed. Three respondents did not know. One additional comment stated "No comparison. I have never trusted LLWAS."

Discussion: These data indicate a preference for ASR-WSP by the majority of user participants in this evaluation.

Questions #5 and #6.

Operational Readiness and/or Changes: Eight evaluators felt that the ASR-WSP is ready for installation and operational use in the field without changes. Nine evaluators disagreed. Nine evaluators felt that the ASR-WSP is suitable for installation, but some changes are necessary prior to operation. Eight disagreed.

Discussion: The changes that respondents suggested that would make the ASR-WSP operationally ready were representative of responses to previous questions. For example, there were six respondents who noted that the size of the RDT was too large. A change in the audio alarm system is needed, according to one respondent. Reliability was an issue noted by one respondent, however, there was no specific information found in participants' responses about data reliability on the ASR-WSP. These suggestions are considered in the Conclusions and Recommendations sections of the report.

Question #7.

Other Comments: Appendix B lists the respondents' additional comments. All those comments indicated a general positive attitude about the ASR-WSP by participants in the evaluation.

6. CONCLUSIONS.

The evaluation of the MIT/LL prototype Airport Surveillance Radar Wind Shear Processor (ASR-WSP) by the Albuquerque International Airport (ABQ) controllers and supervisors provided significant input on the operational suitability of the Geographic Situation Display (GSD) and Ribbon Display Terminal (RDT) and usefulness of the weather products provided by the system in an operational environment. Some significant findings are:

a. Supervisors found the GSD very helpful in making runway configuration changes prior to weather events.

b. The displayed information for both Microburst Alerts (MBAs) and Wind Shear Alerts (WSAs) and the clarity of the displayed GSD and RDT information are very good. The evaluation of the RDT display information was inconclusive due to the limited number of participants who did not provide a numerical rating for the display. This may have occurred due to the limited opportunities for the user participants to observe wind shear alerts during the evaluation.

c. Gust front information was considered as a valuable product; however, the displayed information in most cases was still too late to be beneficial for change in traffic flow.

d. Generally, the controllers felt that the ASR-WSP system was a significant improvement over the Low Level Wind Sheer Alert System (LLWAS) and ASR-9 weather channel for ease of analyzing and broadcasting severe weather products to pilots.

e. The audio alarms were not completely satisfactory. Several respondents could not always hear them.

f. The size of the RDT was thought to be too large, according to several of the user participants. Some felt that the GSD could be better located.

7. RECOMMENDATIONS.

The MIT/LL continues to upgrade and test the Airport Surveillance Radar Wind Shear Processor (ASR-WSP). It is recommended that evaluations of the ASR-WSP continue to be tested at the Albuquerque International Airport (ABQ) in order to obtain more data on dry microburst and wind shear information.

The gust front prediction feature still needs to be improved to where it will provide more advance notice for air traffic flow adjustment.

The size of the Ribbon Display Terminal (RDT) should be considered in any future testing of the ASR-WSP. Many of the respondents felt that the RDT was too large for their limited space. Effort should be made to obtain a small Terminal Doppler Weather Radar (TDWR) RDT.

Research is needed to determine the optimum method for presentation of audio alarms in the air traffic environment. Consideration should be given to the frequency and the volume of the alarms.

Although most respondents liked the trackball operation, it is recommended that further training and testing be conducted to improve the acceptability of the dynamic characteristics of the trackball.

It is recommeded that additional testing be planned to investigate the compliance of Geographic Situation Display (GSD) menus with human factors standards and guidelines and to obtain clarification about the usability of the GSD menus from the users' perspective.

8. ACRONYMS AND ABBREVIATIONS.

ABQ	Albuquerque International Airport
ANR-200	Terminal Radar Program Office (FAA Headquarters)
ASR	Airport Surveillance Radar
ATA	Air Traffic Assistant
ATC	Air Traffic Control
ATCS	Air Traffic Control Specialist
ATCBI	Air Traffic Control Beacon Interrogator
ATCT	Airport Traffic Control Tower
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Manager
FAA	Federal Aviation Administration
GSD	Geographic Situation Display
LLWAS	Low Level Wind Shear Alert System
MBA	Microburst Alert
MDT	Mountain Daylight Time
MIT/LL	Massachusetts Institute of Technology/Lincoln Laboratory
NAS	National Airspace System
NCP	NAS Change Proposal
NOTAM	Notice to Airmen
OT&E	Operational Test and Evaluation
RDT	Ribbon Display Terminal
TDWR	Terminal Doppler Weather Radar
TRACON	Terminal Radar Control
WSA	Wind Shear Alert
WSP	Wind Shear Processor

APPENDIX A

EVALUATION QUESTIONNAIRE

AIRPORT SURVEILLANCE RADAR
WINDSHEAR PROCESSOR (ASR-WSP)
QUESTIONNAIRE

EVALUATOR_____ Supervisor_____ CIC_____ Controller_____
(Initials)

GEOGRAPHICAL SITUATION DISPLAY (GSD)

Using the following scale: 1=very poor, 2=poor, 3=fair 4=good, 5=very good, ?=do not know

1. Rate the following GSD features: (please circle one)

A.	Microburst Alerts						
	1. graphical display	1	2	3	4	5	?
	2. timeliness	1	2	3	4	5	?
B.	Windshear Alerts						
	1. graphical display	1	2	3	4	5	?
	2. timeliness	1	2	3	4	5	?
C.	Gust Front Alerts						
	1. graphical display	1	2	3	4	5	?
	2. timeliness	1	2	3	4	5	?
D.	Storm Motion Prediction Product						
	1. graphical display	1	2	3	4	5	?
	2. timeliness	1	2	3	4	5	?
E.	Anomalous Propagation Censoring						
	1. graphical display	1	2	3	4	5	?
	2. timeliness	1	2	3	4	5	?
F.	Daytime Readability of the GSD	1	2	3	4	5	?
G.	Nighttime Readability of the GSD	1	2	3	4	5	?
H.	Readability in the TRACON	1	2	3	4	5	?
I.	Size of GSD	1	2	3	4	5	?
J.	Situation Display Window Layout (See Figure 1)						
	1. graphic display	1	2	3	4	5	?
	2. weather alerts display	1	2	3	4	5	?
	3. status display	1	2	3	4	5	?
	4. product description display	1	2	3	4	5	?
	5. time/date	1	2	3	4	5	?
K.	Trackball Operation	1	2	3	4	5	?

AIRPORT SURVEILLANCE RADAR
WINDSHEAR PROCESSOR (ASR-WSP)
QUESTIONNAIRE

GEOGRAPHICAL SITUATION DISPLAY (GSD)

L. Alarms

1. graphic	1	2	3	4	5	?
2. audible	1	2	3	4	5	?

Please comment on any rating of 3 or lower._____

_____

_____

_____

2. Did you observe any distortion or flicker on the GSD?
YES_____ NO_____ If Yes please explain_____

_____

_____

3. Are the six colors depicting the intensity of precipitation satisfactory? YES_____ NO_____ If No please explain_____

_____

_____

4. Does the GSD information improve the management of air traffic in the terminal area through the forecast of Gust Front induced wind shifts?
YES_____ NO_____ If No please explain_____

_____

_____

5. Does the GSD information improve the management of air traffic in the terminal area through the Storm Motion Prediction products?
YES_____ NO_____ If No please explain_____

_____

_____

6. Are the GSD menus, prompts and error messages acceptable and adequate for the required multi-step tasks? YES_____ NO_____ Please explain

_____

_____

AIRPORT SURVEILLANCE RADAR
WINDSHEAR PROCESSOR (ASR-WSP)
QUESTIONNAIRE

7. Does the **Anomalous Propagation** editing product improve the radar presentation when compared with the BRITE display?
YES_____ NO_____ If No please explain_____

_____

_____

_____

8. Please provide any other comments on the GSD._____

_____

_____

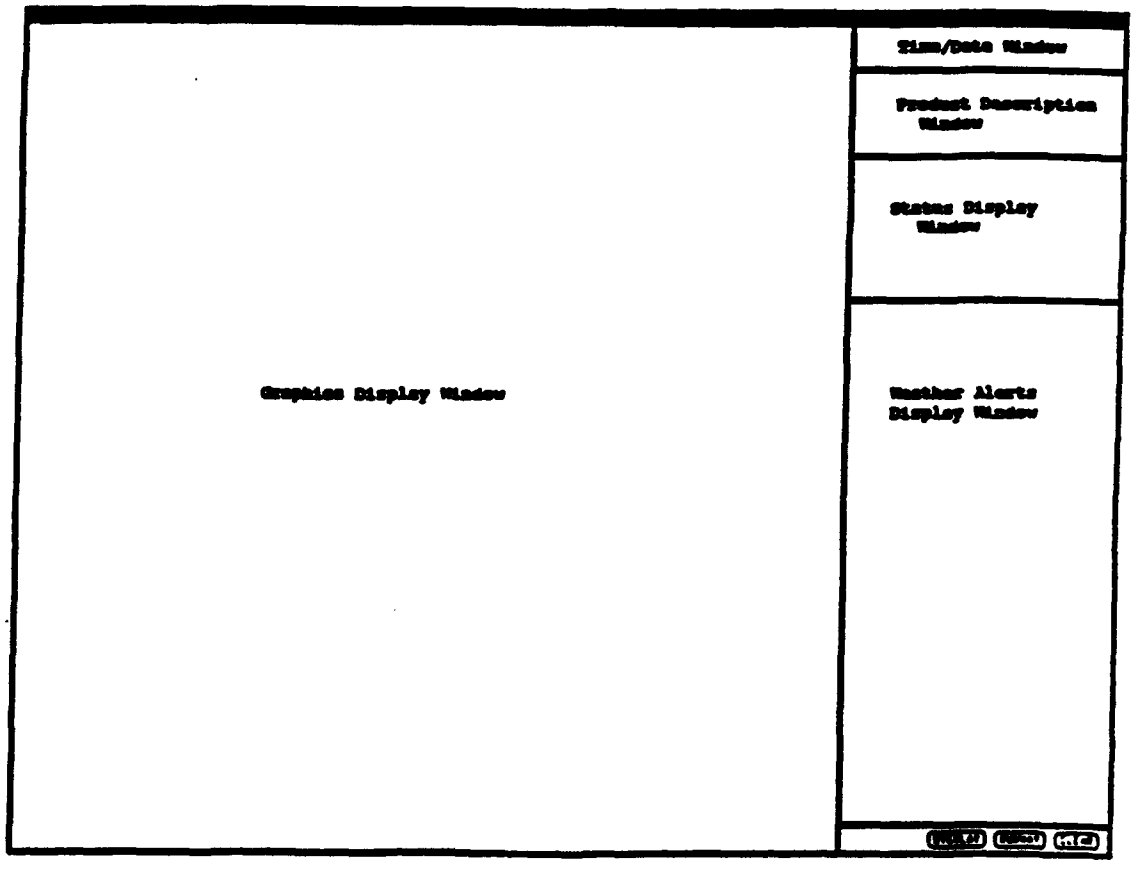

FIGURE 1. SITUATION DISPLAY WINDOW LAYOUT

AIRPORT SURVEILLANCE RADAR
WINDSHEAR PROCESSOR (ASR-WSP)
QUESTIONNAIRE

EVALUATOR_____ Supervisor_____ CIC_____ Controller_____
(Initials)

RIBBON DISPLAY TERMINAL (RDT)

Using the following scale: 1=very poor, 2=poor, 3=fair 4=good, 5=very good, ?=do not know

1. Rate the following RDT features: (please circle one)

A. Microburst Alerts (MBA)						
1. format	1	2	3	4	5	?
2. timeliness	1	2	3	4	5	?
B. Windshear Alerts (MBA)						
1. format	1	2	3	4	5	?
2. timeliness	1	2	3	4	5	?
C. Center Field Wind Messages						
1. format	1	2	3	4	5	?
2. location	1	2	3	4	5	?
D. Daytime Readability	1	2	3	4	5	?
E. Nighttime Readability	1	2	3	4	5	?
F. Readability in TRACON	1	2	3	4	5	?
G. Alarm Adjustment	1	2	3	4	5	?

Please comment on any rating of 3 or lower._____

2. Is the aural alarm satisfactory when multiple Microburst and Windshear alerts are hitting different runways and being displayed on the RDT at the same time? YES_____ NO_____ If No please explain_____

3. Please provide any other comments on the RDT._____

AIRPORT SURVEILLANCE RADAR
WINDSHEAR PROCESSOR (ASR-WSP)
QUESTIONNAIRE

GENERAL

1. Did you receive suitable training to allow you to use the RDT and/or GSD? YES_____ NO_____ If No please explain_____

2. What benefits do you see from the ASR-WSP?_____

3. What problems do you see with the ASR-WSP?_____

4. In comparison with the airport's LLWAS, is the ASR-WSP more effective in detection and display of windshear alerts? YES_____ NO_____
If No please explain_____

5. Do you feel that the ASR-WSP is ready for installation and operational use in the field? (circle one of the letters)

   A. Suitable, install and use, do not make any changes.

   B. Suitable, install and use but some changes beneficial.

   C. Unsuitable, do not install, some changes necessary prior to installation.

   D. Unsuitable, do not install, good concept but extensive redesign necessary.

   E. Unsuitable, do not install, entire concept inappropriate.

   F. Do not know.

6. If you think changes are necessary please list them.

AIRPORT SURVEILLANCE RADAR
WINDSHEAR PROCESSOR (ASR-WSP)
QUESTIONNAIRE

7. Other Comments:_____

_____

_____

If more room is needed for comments or answers use the back of the questionnaire pages.

APPENDIX B

RESPONDENTS COMMENTS

Question: 1. Please comment on any rating of 3 or lower.

Comments: "Too many/much motion required to obtain one operation."

(Question E) "Possibly due to characteristics of the ASR-9, large areas of moisture with little air movement are not displayed."

"I would like an audible alarm to alert the user of a significant (perhaps 5 or 10 kts) during an alarm."

"Needs more alarms per event."

"The Gust Front alert product did not work as well as the others. Several wind shifts occurred without any advance notice."

"Because the GSD is located in an out-of-the-way place, we seldom noticed it, or its audible alarms. The trackball is too sensitive. The RDT is too big and its graphic alarms are sometimes confusing."

Question: 2. Did you observe any distortion or flicker on the GSD?

Response: YES - 0 NO - 16 DO NOT KNOW - 1

Comments: None

Question: 3. Are the six colors depicting the intensity of precipitation satisfactory?

Response: YES - 16 NO - 0 DO NOT KNOW - 1

Comments: None

Question: 4. Does the GSD information improve the management of air traffic in the terminal area through the forecast of Gust Front induced wind shifts?

Response: Yes - 14 NO - 1 DO NOT KNOW - 2

Comments: "Location in the tower cab and TRACON poor"

"Best Feature"

"Timeliness on one Gust Front situation was not satisfactory. Generally, the information has been displayed efficiently."

"Did not witness Gust Front."
"Gust Front Alerts were not up to snuff.

"This function didn't work as well as others. Several wind shifts occurred without any advance notice."

"Problem noted with T-storm along mountains moving north. Received little warning of strong winds coming out of the East across the airport. First real warning was heavy dust movement in construction area northeast of control tower."

Question: 5. Does the GSD information improve the management of air traffic in the terminal area through the Storm Motion Prediction products?

Response: YES - 16 NO - 0 DO NOT KNOW - 1

Comments: None

Question: 6. Are the GSD menus, prompts and error messages acceptable and adequate for the required multi-step tasks?

Response: YES - 13 NO - 3 DO NOT KNOW - 1

Comments: "The runway selection menu procedure seems very cumbersome."

The menus are confusing. A clear menu bar should be provided instead of the scattered "buttons".

"Very easy to use for people without computer experience."

"I would like to see more reliability."

Question: 7. Does the Anomalous Propagation editing product improve the radar presentation when compared with the Brite display?

Response: YES - 13 NO - 0 DO NOT KNOW - 4

Comments: None

Question: 8. Please provide any other comments on the GSD.

Comments: "GSD could be placed closer to Local Control."

"This has provided us with a very helpful tool in providing better service."

"Any way of putting the GSD near the actual radar control positions would be of greater real time use."

"I like this equipment."

"Very good tool - will save some lives - leave it here."

"I am extremely impressed and feel we will be taking a strong tool away when it is gone."

"As an ATA I put on ATIS and tower observed weather information. On Friday, August 27th MBAs of 35-45Kts from about 8 miles South moved slowly North to over the airport and across the final approach. The Clearance Delivery (CD) person can provide very useful and timely information via supplemental ATIS and broadcast to aircraft waiting departure on the CD frequency (during Gate Hold Procedures). Several pilots commented on what we were able to provide them, including an estimate on when we would likely be able to resume arrivals and departures. As a pilot and old controller, I see a lot of use for it (ASR-WSP) here."

"Should be located closer to Local Control and reduced in size if possible. Actual location of the unit during the evaluation phase was not ideal. In the real world two units placed well would be a Godsend."

"Graphics are very well done."

"Very useful. Good informative display."

II. RIBBON DISPLAY TERMINAL

Question: 1. Please comment on any rating of 3 or lower.

Comments: "RDT too big."

"RDT too big. It blocks visibility in the cab."

"Location of the unit was poor. No volume at all."

"WSAs needed to be pretty close to the airport to display. I felt that better information from my positions standpoint was obtained from GSD but then I had time and could turn to see GSD where Local Controller may not and I realize that both (displays) would be better located later."

"Location of unit not readily visible from North scope. I suppose this would be corrected in the future."

Question: 2. Is the aural alarm satisfactory when multiple MBAs and WSAs are hitting different runways and being displayed on the RDT at the same time?

Response: YES = 5 NO = 4 DO NOT KNOW = 8

Comments: "Did not hear an alarm."

"Did not hear an alarm."

"I believe another alarm within an alert to warn of a significant change would be useful."

"Should be individual alarms for each incident instead of five minute segments."

"Each change of events should require an alarm."

"I did not hear it a couple of times."

"Cannot hear it."

Question: 3. Please provide any other comments on the RDT.

Comments: "RDT is a bit too large depending on where it would be located. TRACON probably good as viewing from possibly greater distance."

"Maybe something to draw your attention to a particular runway wind quicker, it may be that I'm not used to it yet."

"Easy to read."

"The ability to configure to actual runways in use is excellent."

"A very useful tool for air traffic."

"LLWAS alarmed with wind shear, RDT did not. We were told that the RDT would not alarm unless wind shear was associated with weather. We told Lincoln Labs this was not acceptable because we frequently get wind shear in clear weather conditions. They said they would try to correct."

"The RDT is way too big. Its location would block the view for Ground Control to see the terminal."

"The equipment is too large, I hope the final product is smaller."

III. GENERAL

Question: 1. Did you receive suitable training to allow you to use the RDT and GSD?

Response: YES = 17 NO = 0 DO NOT KNOW = 0

Comments: "We had a very detailed training session but a refresher would be nice."

"Very good training session. Very informative."

"The folks at MIT/LL took a deal of time to ensure we understood the equipment."

Question: 2. What benefits do you see from the ASR-WSP?

Comments: "Predicted wind shifts, front movements, most important this equipment provides an added margin of safety for our flight customers."

"Seeing and anticipating where the weather will be."

"Greater awareness of MBA and WSA activity. Ability to predict such and to plan accordingly; improve traffic flow."

"The capability to advise pilots of instantaneous WSA and MBA activity is a tremendous improvement over LLWAS."

"Increased service and safety to the air system users."

"RDT display of WSA and MBA is much more comprehensive than LLWAS."

"Detection of MBA are excellent. Also storm movement and speed."

"More accurate information - more useful to pilots."

"More information available to the pilots and better planning."

"Predicting a runway change. More accurate information. More usable for the pilots. The LLWAS is a hunk of junk. Planning delays."

"Color coded cell strength is great. Very accurate MBA information. Accurate storm movement."

"Too numerous to list."

"Better service to pilots especially predicting runway changes and anticipating pilots requests for deviations."

"Gives controllers a very useful tool to provide up-to-date weather information in the terminal and radar environments. Pilots seemed very impressed with the product."

"Very beneficial to pilots if relayed in a timely manner."

Question: 3. What problems do you see with the ASR-WSP?

Comments: "Too large and bulky."

"Monitor at Local Control Position in tower cab should be moved. What will the system cost?"

"None so far."

"Ribbon display is too big."

"None except hardware size."

"Some reliability problems but even with that its 10 times better than the LLWAS."

"Additional requirement complicating separation of aircraft."

"None. It can only help."

"None"

"At this point none."

"Having more information than can be rapidly transmitted to users during heavy traffic."

"I would like an aural alarm during an alert to warn a user of a significant change to the alert."

"None."

"Delay in receiving the equipment. This should be a high priority item, especially in the mountainous areas due to violent thunderstorms."

Question: 4. In comparison with the airport's LLWAS, is the ASR-WSP more effective in detection and display of wind shear alerts?

Response: YES = 13 NO = 1 DO NOT KNOW = 3

Comments: "No comparison. I have never trusted LLWAS."

Question: 5. Do you feel that the ASR-WSP is ready for installation and operational use in the field?

Response: A. Suitable, install and use, do not make any changes.
8 evaluators agreed, 9 evaluators disagreed

B. Suitable, install and use but some changes necessary prior to installation.
9 evaluators agreed, 8 evaluators disagreed

There were no C through F responses.

Question: 6. If you think that changes are necessary please list them.

Response: "RDT too large."

"Display size of RDT."

"More reliability, location of the units in the tower and tower needs to be better."

"RDT should be smaller."

"Separate GSDs placed next to radar control positions."

"Change in aural alarm system."

"Smaller RDT. When wind shear occurs, Blinking (visual) alarm of affected boundary."

"Size of RDT for tower. Perhaps 2 sizes, one for tower and one for the TRACON."

"Reduce size and change location of RDT and GSD."

Question: 7. Other comments:

Comments: "Evaluation Conductor was most helpful and professional in explaining and monitoring the WSP test phase."

"Has proved very useful here for timely weather information to pilots we've never had before and also good heads up for runway change except as noted."

"I hope we proceed with acceptance and installation with minimum delay."

"Impressive equipment. The people involved are patient, helpful and overall great to work with."

"This system will require recurrent training, not just once and leave it."

"I think it's great. I'm gonna be read sad when it leaves."